Farnell

LFM2

SINE/SQUARE OSCILLATOR

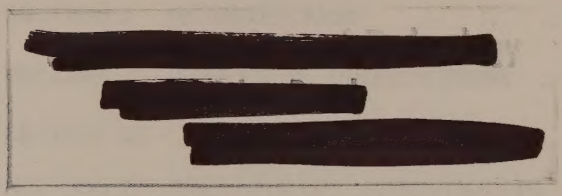
ISSUE 4

INSTRUCTION BOOK

MP MASTER

MA23425

FARNELL INSTRUMENTS LIMITED



INSTRUCTION MANUAL

LFM2
SINE/SQUARE OSCILLATOR

ISSUE 4

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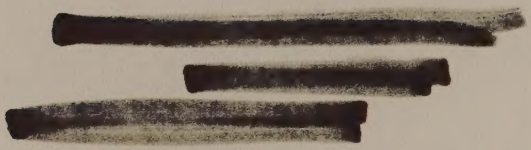

CONTENTS

		Page No.
SECTION I	INTRODUCTION	1
SECTION II	OPERATING INSTRUCTIONS ..	2
SECTION III	CIRCUIT DESCRIPTION	3
SECTION IV	PRELIMINARY ADJUSTMENTS	6
SECTION V	RE-SETTING THE FREQUENCY RANGE	7
SECTION VI	SPECIFICATION	8

SECTION I

INTRODUCTION

The LFM2 oscillator provides a source of sine and square waves over a frequency range of 1 c/s to 1 Mc/s.

The frequency is continuously variable over six decade ranges, the slow motion and large scale allowing easy setting. The frequency range is set by the push button switch.

Signal amplitude is set by the continuous control and the four position step attenuator which gives 20 db per step. The useful signal output can be varied over the range 1 mv to 12 v peak to peak. The output level is indicated on the meter.

The instrument may be operated from 190v—260v or 95v—130v 50 c/s A.C. Mains Supply. Alternately the internal batteries may be selected.

The output terminals are isolated from the chassis so that the instrument can provide an output isolated from earth.

SECTION II

OPERATING INSTRUCTIONS

Installation

The instrument is powered from the mains A.C. or from internal batteries if fitted. If the battery supply is required, three PP9 batteries are fitted in the battery compartment which is accessible by removing the lower cover. The selector switch on the back panel should be set at "batteries" and the instrument will operate when switched "on." The battery life is of the order of 70 hrs. with normal usage.

When operating from the mains supply, the mains/battery selector switch on the back panel must be set accordingly. No mains voltage selector is fitted or required over the range of voltages encountered. To operate from a nominal 115v supply (95v—130v), the supply to the transformer must be connected to the primary centre tap.

240v A.C.	Pink (Live) to pins 7 & 10 on C.B.
	Black (Neutral) to pins 9 & 12 on C.B.
110v A.C.	Pink to 7 & 10
	Black to 8 & 11

The three core mains cable should be wired as follows :—

BROWN	Mains Live
BLUE	Mains Neutral
GREEN/YELLOW	Earth

Operation

The unit is switched on by the ON/OFF switch on the front panel. The frequency is indicated by the dial and the range selector switch. Six decade ranges are available covering the frequencies from 1 c/s to 1 Mc/s.

SINE or SQUARE wave output is selected by the push button adjacent to the range switch.

The output amplitude is set by the continuous control or the 20 db per step attenuator. The meter indicates the peak to peak output voltage, on 0 db range of the stepped attenuator, into a load of 600Ω. The error in this indication is less than 5% of full scale deflection. The meter also has a db scale, calibrated with respect to 0 dbM on sine wave output (2.18v pk—pk into 600Ω).

The meter may also be used to check the batteries by selecting the battery test position on the rear panel and ensuring that the meter deflection exceeds the mark on the meter scale.

SECTION III

CIRCUIT DESCRIPTION

The instrument is constructed with the majority of components mounted on a single printed circuit board and with the frequency determining components mounted on a supplementary board located on the frequency range switch.

The circuit may be divided into the following sections for the purpose of description :—

1. Oscillator
2. Square wave circuit
3. Output amplifier
4. Power supply
5. Output metering circuit

1. *Oscillator Circuit*

The frequency is determined by a Wien bridge network. The frequency can be varied by rotation of the double gang potentiometer to cover a decade range. To select further decade ranges, the two bridge capacitors are switched using the push button switch. These frequency determining components are mounted on the printed circuit board behind the range switch. The frequency is set by additions of small padding capacitors and adjustment of the trimmer potentiometers also mounted on the board. Access to the board is easily achieved by removing the lower panel.

Transistors VT1, VT2 and VT3 form a feedback amplifier with a thermistor in the negative feedback path and the Wien bridge network in the positive feedback path. Since a gain of only 3x is required to sustain oscillations with the network used, a large amount of feedback can be applied. The bandwidth of the amplifier at this gain is increased considerably and little phase shift occurs in the amplifier even at the highest frequency of operation. Frequency is therefore determined entirely by the network components. The thermistor characteristic is such that the resistance decreases rapidly when the signal across it exceeds 7v peak to peak. The output from the oscillator is therefore of this order. P1 sets the level of signal feed from the oscillator to the output section.

A sync output signal is taken from the feedback path via R7 to the front panel or a signal can be fed into the oscillator at this point to lock the instrument to an external frequency or the harmonic of an external frequency. The instrument in these conditions can act as a frequency multiplier or as a narrow band filter.

2. *Squaring Circuit*

When a square wave output is required, the oscillator signal is fed into the Schmitt Trigger circuit formed by VT4 and VT5. The circuit values are designed to give a 5v pk—pk output signal into a 1 KΩ load formed by potentiometer P16. The mark to space ratio of the square waveform can be set by adjustment of P2. The Schmitt trigger circuit is bypassed when the sine wave output is required.

3. *Output Amplifier*

Sine wave or square wave signals of equal amplitudes are switched into the output level potentiometer from which the variable level signal feeds the output feedback amplifier. VT6—VT10 form the output amplifier. The signal is fed in via C5 and the feedback voltage is developed across P3 and R22. P3 sets the closed loop gain of the amplifier to be the order of 3x. Cf is a small compensation capacitor across the feedback resistor R23. It is formed from two short wires and is pre-adjusted to remove overshoot on the square wave form. The rise time of the square wave is approximately 100 *n* sec.

Due to the high feedback factor, the output impedance of the amplifier is very low. The instrument output impedance is determined by series resistor R32. The d.c. level at the output is set by adjustment of P4 to be Ov, the output being d.c. coupled in order to give a satisfactory square wave output at low frequency.

The switched attenuator following the amplifier gives 20 db steps with switch positions at 0, —20 db, —40 db and —60 db. The output impedance of the attenuator is 60Ω enabling the instrument to drive a low impedance if required, but the output is calibrated into 600Ω as this is a popular load at the frequencies covered. The low impedance output has the advantage that the output voltage level does not depart very far from calibration when the load is removed.

4. *Power Supply*

The supply voltage is fed to the transformer via the fuse and ON/OFF switch in the mains "live." The transformer primary is centre tapped and the supply is connected to the centre tap when the instrument is operated on 115v. A.C. The rectified voltage feeds the series stabiliser transistor VT13 which gives an output voltage of 20v set by P8.

VT11 is a means of centre tapping the supply to give +10v and —10v, on the correct adjustment of P7.

No voltage selector is fitted as the instrument will operate over a wide range of input voltages, i.e. 190v to 260v A.C.

When internal battery supplies are selected by the switch on the rear panel of the instrument, the battery voltage is applied to the stabiliser, enabling the instrument to operate over a range of battery volts. The expected battery life is approximately 70 hrs. with three hours use per day.

5. *Meter Circuit*

The signal from the output amplifier is metered prior to feeding the stepped attenuator and is displayed on the meter. The signal is rectified in the bridge D3 to D6. The detector is an averaging circuit and gives a different output for sine and square waves. The potentiometer P5 which is switched out on sine waves equates the meter readings.

P6 is set to give a full scale deflection when the output voltage is 12v pk—pk into 600Ω. The frequency response of the meter circuitry is level over the middle ranges of the instrument, but below 4 c/s the meter needle oscillates.

SECTION IV

PRELIMINARY ADJUSTMENTS

Remove covers from the instrument and ensure that the mains supply input is connected to the correct tap on the transformer, i.e. pin 11 for 115v or pin 12 for 230v A.C.

Check the position of the switches on the rear panel. These should read "NORMAL" and "MAINS."

Connect the mains supply and switch on the instrument. The following procedure should now be followed :—

(*a*) Measure voltage between the positive side of C1 and negative side of C2. Adjust P8 for this to be 20 volts.

(*b*) Monitor the voltage across C1 or C2 and adjust P7 for this to be 10v.

(*c*) Switch the attenuator to the maximum output position, i.e. fully clockwise. Set frequency control to 1 Kc/s and select SINE wave output. Set continuous output level control on the front panel to give minimum output.

(*d*) Monitor the D.C. voltage at output terminals and set to zero by adjustment of P4.

(*e*) Increase output by rotating the continuous control on the front panel and ensure by monitoring by oscilloscope that a sine wave output is available.

(*f*) Depress "SQUARE" wave output button. Adjust control P2 to give 1 : 1 Mark/space ratio output waveform.

(*g*) Load the output terminals with 600Ω resistor and monitor the output across this resistor. With the continuous output level control set to give maximum output, set gain of output amplifier by adjustment of P3 to give 12v pk—pk output.

(*h*) Switch to SINE wave output and adjust P1 to give 12v pk—pk output.

(*i*) Adjust P6 to give a reading of 12v on the output level meter.

(*j*) Switch to SQUARE wave output and adjust P5 to give a reading of 12v on the output level meter.

(*k*) Check operation on batteries and "battery test" switch.

The above procedure should be followed by the frequency setting procedure given in the following Section V.

SECTION V

RE-SETTING THE FREQUENCY RANGE

The frequency determining components are mounted on the smaller printed circuit board which is mounted directly on the range switch. If it is required to reset the frequency range, this can be accomplished by adjusting the variable resistors and selected capacitors on the board. The full procedure for setting the frequency ranges is given below.

Set the instrument for sine wave output and monitor the output frequency using a suitable counter or timing instrument.

i Disconnect the wires to the frequency control potentiometer P15a and P15b and connect the two in parallel. Set the potentiometer to give a resistance of 350 ohm. With the resistance at this value, the frequency dial should be fixed such that the frequency indicated at the cursor is 8. Re-connect the potentiometer to the instrument.

ii Adjust the variable resistors P9 to P14 at the mid point of travel.

iii *x1 Range.* With the frequency multiplier set to x1 and the frequency scale set to 1, select a value for C18 such that the output frequency is 1 c/s. Rotate the frequency scale to 10 and adjust P9 to give an output frequency of 10 c/s.

iv *x10 Range.* Set frequency range to x10 and frequency scale to 1, select C20 to give 10c/s. Rotate frequency scale to 10 and set P10 to give output frequency of 100 c/s.

v *x100 Range.* Set frequency multiplier to x100 and frequency scale to 1. Select C22 to give 100 c/s. Rotate the frequency scale to 10 and set P11 to give an output frequency of 1 Kc/s.

vi *x1K.* Set frequency multiplier to x1K and frequency scale to 1. Select C24 to give 1 Kc/s. Rotate the frequency scale to 10 and set P12 to give an output frequency of 10 Kc/s.

vii *x10K.* Set frequency multiplier to x10K and frequency scale to 1. Select C26 to give 10 Kc/s. Rotate the frequency scale to 10 and set P13 to give an output frequency of 100 Kc/s.

viii *x100K.* Set frequency multiplier to x100K and frequency scale to 1. Adjust C28 to give 100 Kc/s. Rotate the frequency scale to 10 and set P14 to give an output frequency of 1 Mc/s.

NOTE.—Frequency adjustment should be carried out to within $\pm 1\%$ of the nominal value except on the x1 range where ± 0.25 c/s is sufficiently accurate.

Specification

FREQUENCY RANGE	1 Hz to 1 MHz in six decade ranges
SCALE ACCURACY	To within ±3% of scale reading or ±0.25 Hz
HARMONIC DISTORTION	Less than 0.5% 10 Hz to 100 kHz Less than 2% 1 Hz to 1 MHz
SQUARE WAVE RISE TIME	Less than 150 nS
FREQUENCY STABILITY Typical stability over ±7.5% variation of nal mains (after 30 minutes warm up) Typical stability with temperature (after 30 minutes warm up)	 Less than 0.004% Less than 0.03% per °C
AMPLITUDE STABILITY	Less than ±2% 10 Hz to 100 kHz Less tnan ±5% 1 Hz to 1 MHz
Typical amplitude stability over ±7.5% variation of nominal mains al amplitude stability with temperature	Less than 0.2% Less than 0.3% per °C
OVERALL STABILITY Typical, for a 5°C rise in ambient and 5% reduction in mains voltage	 Frequency : 0.2% Amplitude : 2%
OUTPUT VOLTAGE	1 mV to 12 Volts peak to peak
OUTPUT IMPEDANCE	60 Ω approx. Calibrated into 600 Ω
SYNC. OUTPUT	Greater than 5V peak to peak
LOCKING RANGE for 1V pk-pk lock signal	±0.75% of output frequency
AMBIENT TEMPERATURE RANGE for normal operation	0°C to 40°C
POWER REQUIREMENTS	A.C. mains : 190 to 260V or 95 to 130V by internal link change 47–400 Hz Batteries : 27V d.c. from three integral PP9 batteries Battery life : Typically 70 hours for 3 hours use per day.
DIMENSIONS overall approx.	Height 162 mm (6⅜″) Width 244 mm (9⅝″) Depth 254 mm (10″)
WEIGHT including batteries	5.33 kg (11¾ lbs.)

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